TROCAR SYSTEM HAVING SHIELDED TROCAR

Related Applications

This application is a ~~continuation~~ CONTINUATION-IN-PART of U.S. Design Patent Application No. 29/117,520 filed on January 26, 2000, the entire disclosure of which is hereby incorporated herein in its entirety by reference.

Field of the Invention

The present invention relates to the field of medical devices and, more particularly, to trocar systems and methods.

Background of the Invention

Trocar systems have been developed over the years for various endoscopic applications in the field of medicine. These trocar systems conventionally include a cannula through which a trocar or obturator or other endoscopic related tool extends. The trocar can be shielded or unshielded. Examples of shielded trocars can be seen in U.S. Patent No. 4,654,030 by Moll et al. titled *"Trocar,"* U.S. Patent No. 4,931,042 by Holmes et al. titled *"Trocar Assembly With Improved Latch,"* U.S. Patent No. 4,902,280 by Lander titled *"Trocar,"* and U.S. Patent No. 5,030,206 by Lander titled *"Trocar."* Other shielded trocars which are more cost effective to

manufacture, less bulky to handle and ship, and yet produce reliable performance, however, are still needed.

It is also known to use one or more valves positioned within or connected to a proximal end of the cannula of a trocar system. Examples of such trocar systems having one or more valves in the cannula thereof can be seen in U.S. Patent No. 5,226,891 by Bushatz et al. titled *"Seal Protection Apparatus,"* U.S. Patent No. 5,308,336 by Hart et al. titled *"Seal Protection Mechanism,"* U.S. Patent No. 5,385,553 by Hart et al. titled *"Trocar With Floating Septum Seal,"* U.S. Patent No. 5,782,812 by Hart et al. titled *"Seal Assembly For Access Device,"* U.S. Patent No. 5,443,452 by Hart et al. titled *"Seal Assembly For Access Device,"* and U.S. Patent No. 5,209,737 by Ritchart et al. titled *"Lever Actuated Septum Seal."*

These devices, however, often have complex mechanical valves which can be difficult and expensive to manufacture. Accordingly, after use in surgical procedures, e.g., endoscopic, the cannulas having the valves therein are often thrown away, especially if they are not sterilizable. Therefore, this expensive cost is often past on to insurance providers and patients whom upon whom they are used.

Others of these valves for cannulas of trocar systems do not have complex mechanical valves, but can still be expensive or more difficult to manufacture. As costs often rise in the health care industry, insurance, consumers, and governmental agencies often strive to drive prices for medical devices down. Also, these other valves are often not flexible for various uses by physicians or medical personnel during surgical procedures and often can be damaged. Accordingly, there is also still a need for alternative cannula and valve

configurations for trocar systems, a need less expensive trocar systems, a need for more flexible trocar systems which enhance handling thereof by medical personnel users, i.e., physicians, and trocar systems which are still effective for various endoscopic surgical procedures.

Summary of the Invention

With the foregoing in mind, the present invention advantageously provides a trocar system having relatively low costs associated with the manufacturing of components of the system, e.g., cannula, trocar, valves, and thereby reduces the cost associated with the trocar system. The present invention also advantageously provides a trocar system which enhances handling by physicians or medical personnel during surgical procedures. The present invention additionally advantageously provides a more flexible trocar system which is effective during various endoscopic surgical procedures. The present invention still also advantageously provides a cannula and a trocar which each are more ergonomic and easy to use. The present invention further advantageously provides enhanced methods of using and handling a trocar system during surgical procedures.

More particularly, the present invention advantageously provides a trocar system which includes a cannula having an elongate cannula body. The cannula body includes medial and distal portions thereof having a first diameter and a proximal portion thereof connected to the medial portion and having a second diameter. The second diameter is preferably larger or greater than the first diameter. A trocar having an elongate trocar body also extends through the cannula. The elongate trocar body has a sharpened distal end portion, a medial portion

thereof having a first diameter, and a proximal portion having a second diameter. The second diameter is preferably larger or greater than the first diameter. The trocar also has a handle connected to a proximal end portion of the trocar body for gripping of and handling of the trocar by a hand of a user and a shield slidably mounted to the medial portion of the trocar body and biased in an extended position so that a distal end of the shield coveringly protects the sharpened distal end of the trocar body until pressure is applied thereagainst so that the shield slidably moves toward the proximal portion of the trocar body in a retracted position. The shield has a third diameter which is preferably at least equal to or less than the second diameter.

Brief Description of the Drawings

Some of the features, advantages, and benefits of the present invention having been stated, others will become apparent as the description proceeds when taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective environmental view of a trocar system positioned within a layer of epidermis of a patient according to the present invention;

FIG. 2 is a side elevational view of a trocar system according to the present invention;

FIG. 3 is a fragmentary sectional view of a trocar system having primary and secondary valves taken along line 3-3 of FIG. 1 according to the present invention;

FIG. 4 is a fragmentary perspective view of a primary valve of a trocar system according to the present invention;

FIG. 5 is a sectional view of a primary valve of a trocar system taken along line 5-5 of FIG. 4 according to the present invention;

FIG. 6 is a fragmentary top plan view of a shielded obturator of a trocar system according to the present invention;

FIG. 7 is a top plan view of an obturator removed from the shield of a shielded obturator of a trocar system according to the present invention;

FIG. 8 is a top plan view of a shield of a shielded obturator of a trocar system according to the present invention;

FIG. 9 is a perspective view of a secondary valve of a trocar system according to the present invention;

FIG. 10 is sectional view of a secondary valve of a trocar system taken along line 10-10 of FIG. 9 according to the present invention;

FIG. 11 is a top plan view of another embodiment of a primary valve of a trocar system according to the present invention;

FIG. 12 is a perspective view of another embodiment of a primary valve of a trocar system according to the present invention;

FIG. 13 is a sectional view of another embodiment of a primary valve of a trocar system taken along line 13-13 of FIG. 11 according to the present invention;

FIG. 14 is an enlarged fragmentary side plan view of a shielded trocar of a trocar system according to the present invention; and

FIG. 15 is a sectional view of a shielded trocar of a trocar system taken along line 15-15 of FIG. 14 according to the present invention.

Detailed Description of Preferred Embodiments

The present invention will now be described more fully hereinafter with reference to the accompanying

drawings which illustrate preferred embodiments of the invention. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout, the prime notation, if used, indicates similar elements in alternative embodiments.

FIG. 1 illustrates a trocar system **20** which preferably includes a cannula **30** having an elongate cannula body **31**. The cannula body **31** includes distal **32** and medial **33** portions thereof having a first diameter and a proximal portion **34** thereof connected to the medial portion **33** and having a second diameter. The second diameter is preferably larger or greater than the first diameter as illustrated. The trocar system **20** also has finger gripping means **35** connected to and extending outwardly from the proximal portion **34** of the cannula body **31** for gripping the cannula **30** with the fingers **F** of a hand **H** of a user **U** and a trocar **40** having an elongate trocar body **41** for extending through the cannula **30**. The trocar **40** also has a handle **50** connected to the trocar body **41** for gripping of and handling of the trocar **40** by a hand **H** of a user **U**.

As perhaps best shown in FIGS. 1-3, the finger gripping means **35** of the trocar system **20**, for example, can be provided by a pair of finger grips **36, 37** connected to outer surfaces of the proximal portion of the cannula body. Each of the pair of finger grips includes a finger support web **38, 39** to thereby define a

pair of finger support webs. Each of the pair of finger support webs **38, 39** is connected at a position substantially 180 degrees from the other of the pair as illustrated. The medial portion **33** of the cannula body **31** connects to the proximal portion **32** of the cannula body at an area defining a proximal transition region **25**. Each of the pair of support webs **38, 39** has a distal peripheral surface **28, 29** which extends outwardly from the proximal portion **34** of the cannula body **31** and extends proximally from a plane substantially perpendicular to the transition region **25** of the cannula body **31**.

Also, each of the tactile finger support webs **38, 39** preferably has a roughened or ridged outer peripheral surface for reducing finger slippage when positioned on the finger support webs **38, 39** (see FIG. 2). Each of the pair of finger support webs **38, 39** are preferably formed integrally with the cannula body **31** as a single piece. At least one of the pair of finger support webs **38** includes an auxiliary fluid port **22** extending through a medial portion of the fluid support web **38** to allow fluid, e.g., gas or liquid, to flow therethrough. A flow control valve **24**, e.g., a stop flow or on/off flow valve which slidably extends across the port **22**, is associated with the auxiliary fluid port **22** of the at least one **38** of the pair of finger support webs **38, 39** for controlling fluid flow, such as carbon dioxide, through the auxiliary fluid port **22** to the inner tubular portions of the cannula as illustrated.

Additionally, the medial portion **33** of the cannula body **31** includes a plurality of rib members **27**

formed integrally with and extending outwardly from the outer surface of the cannula body **31**. As understood by those skilled in the art, the rib members form fascia threads, but the medial portion can be smooth as well. The distal end portion **32** has peripheral cannula opening portions which are beveled and angle proximally from a first plane extending substantially perpendicular to a distal end of the distal portion of the cannula body **31** and extend along a second plane transverse to the first plane. The distal end portion, in essence, has distal bevel sheds forming a pre-peritoneal tent. The trocar body **41** of the trocar **40** has a sharpened distal end portion **42** and a shield **47** at least partially covering the distal end **42**.

According to additional aspects of the present invention, a cannula body end housing **60** is readily detachably connected to the proximal portion **34** of the cannula body **31** for housing at least one valve therein. First and second trocar valves **62, 66** are either positioned substantially within or have portions positioned within the cannula body end housing **60** as illustrated, and each has an opening **63, 67** in a medial portion thereof. The first valve **62** is positioned proximal of the second valve **66** and is preferably positioned entirely within the housing **60** as shown. The trocar **40** has an elongate trocar body **41** which also extends through the cannula body end housing **60**, the respective openings **63, 67** of the first and second trocar valves, and the cannula body **31**.

The first or primary valve **62** is preferably formed of an elastomeric material which slidably deforms

around the body of the trocar **40** when positioned therein to seal outer peripheries of the trocar body **41** abuttingly contacting inner peripheries of the opening **63** of the first valve **62**. The first valve **62** has a substantially planar proximal surface **64** and a substantially planar distal surface **65**. In a first embodiment of the first or primary valve, the elastomeric material preferably includes a fiberous material being impregnated with a silicon material to enhance the strength of the valve **62** and to enhance sliding and sealing of the body **41** of the trocar **40** (see FIGS. 4-5). In this embodiment, the fiberous material can also have accumulations or beads of silicon or other similar materials positioned around outer peripheries and/or around the opening **63** thereof. In a second or alternative embodiment, the first or primary valve **62'** is preferably formed of a Neoprene material as understood by those skilled in the art, e.g., Nylon and/or Lycra material, such as used in dive suits or other type of applications (see FIGS. 11-13). The Neoprene material preferably has a closed-cell configuration and is laser cut for forming the valve. The first valve **62, 62'** preferably has a stretching or elastic range to readily accomodate, e.g., auto-reduction, trocars or other instruments having a diameter of about 4 millimeters to about 13 millimeters as understood by those skilled in the art while still maintaining pneumoperitoneum. The second valve **66** preferably has this range as well, but individually can even have a greater range, e.g., 0 mm to 13 or 14 mm. Accordingly, with the first and second valve **62, 66** in combination, the trocar system advantageously can receive different diameter instruments without the necessity of switching cannulas or valve

systems. Notably, the first valve **62, 62'** is also preferably fixedly secured to the end housing, e.g., preferably by the outer peripheries thereof between lips, edges, or inwardly extending projections of portions of the housing **60**, to enhance guiding, sealing, and other performance criteria of the primary valve **62** in the trocar system.

The second valve **66** preferably has an annular flange portion **71** for enhancing positioning of the second valve **66** within the end housing **60**, annular-shaped sidewalls **68** connected to the annular flange and extending distally when positioned in the end housing, and at least a pair of valve flaps **69** connected to and extending inwardly from the sidewalls **68** and/or flange portion **71**. The sidewalls, for example, can extending distally of the end housing so that the flange portion **71** retains only portions of the valve within the end housing and yet slidably or in a spaced-apart relation have other portions which are positioned within the proximal portion of the cannula body. The pair of valve flaps **69** have at least one slit along common peripheral edges thereof through which the trocar body **41** extends. The second valve **66** also preferably has ribs or rib members connected to, e.g., formed integrally therewith as a single piece, the sidewalls **68** as illustrated to reduce drag as will be understood by those skilled in the art. The second valve is also preferably impregnated with a lubricant such as an oil material to enhance performance of the valve.

The end housing **60** has a substantially annular shape, has a first opening **58** at a proximal end, and has a second opening **59** at a distal end. The first valve **62**

is positioned adjacent the first opening **58**, and the second valve is positioned spaced-apart from the first valve **62** and adjacent the second opening **59**. The outer surface of the end housing **60** is roughened to enhance gripping and rotating thereof by a hand of a user when readily detaching the end housing **60** from the proximal portion of the cannula body **31**. The proximal end portion of the cannula body **31** has at least one end housing mating portion **26** associated therewith and the end housing **60** also has at least one cannula body mating portion **27** associated therewith so that the end housing **60** matingly attaches to the cannula body **31** in a secured position and whereby movement of the end housing **60**, e.g., rotational, by a hand of a user releases, e.g., unsecures or unlocks, the respective mating portions **26, 27** for ready removal of the end housing **60** by the user with the first and second valves **62, 66** positioned therein and so that specimens, e.g., tissue, can be readily removed from the cannula body **31** without damage by the first and second valves **62, 66**. The cannula body **31** is preferably formed of a clear plastic material so that direct visualization of specimen removal and instrument passage can be advantageously provided. This, for example, allows various types of cutting, gripping, or other types of tools to be inserted through the cannula **30** for various endoscopic procedures.

According to yet another aspect of the present invention, the trocar **40**, or spike or obturator if used as well, of the trocar system **20** preferably has an elongate trocar body **41** for extending through the cannula **30**. The elongate trocar body **41** has a sharpened distal

end portion **42**, a medial portion **43** thereof having a first diameter, and a proximal portion **44** having a second diameter. The second diameter is preferably larger or greater than the first diameter. The trocar **40** also has a handle **50** connected to a proximal end portion **44** of the trocar body **41** for gripping of and handling of the trocar **40** by a hand **H** of a user **U** and a shield **45** slidably mounted to the medial portion **43** of the trocar body **41** and biased in an extended position so that a distal end **46** of the shield **45** coveringly protects the sharpened distal end **42** of the trocar body **41** until pressure is applied thereagainst so that the shield **45** slidably moves toward the proximal portion **44** of the trocar body **41** in a retracted position. The shield **45** preferably has a third diameter which is at least equal to or less than the second diameter as illustrated.

The shield **45** has a tubular-shaped shield body **47** that substantially surrounds the medial portion **43** of the trocar body **41** and biasing means, e.g., provided by a spring **48** or other biasing member, positioned between an outer surface of the medial portion **43** of the trocar body **41** and an inner surface of the tubular-shaped shield body **47**. The trocar body **41** preferably includes a trocar body transition region having an outer surface extending outwardly from the medial portion **43** to the proximal portion **44** and defining a shield stop **49** when the shield **45** is biased to the retracted position. The shield stop **49** is preferably a first shield stop, and a second shield stop **46**, such as provided by a rod or pin member can also or alternatively be connected to the trocar body **41** and

cooperates with the shield body **47**, e.g., to through a slot formed therein, to provide an alternative or an auxiliary stop for the shield body **47** when moving to the retracted position.

The sharpened distal end portion **42**, e.g., preferably having a pyramidal tip, of the trocar **40** preferably has a fourth diameter. The fourth diameter is preferably larger than the first diameter of the medial portion **43** of the trocar body **41**. The shield body **47** also preferably has a beveled distal end which corresponds to the shape and position of the sharpended distal end portion and which extends beyond a distal end of the sharpened distal end portion **42** of the trocar body **41**. This shield body can, for example, have a protruding section as illustrated or have other shaped protruding section, e.g., a nosed or other tip with which contact allows the shield body to retract and yet not significantly damage the object, tissue or other item to which it abuttingly contacts.

As illustrated in FIGS. 1-13, the present invention also includes a method of handling a trocar system **20**. The method includes gripping a cannula **30** with fingers **F** of a hand **H** of a user **U** so that the fingers **F** abuttingly contact at least one support web **38, 39** connected to and extending outwardly from a body **31** of the cannula **30** and slidably positioning a trocar **40** through the cannula body **31** when being gripped by the fingers **F** of the hand **H** of the user **U**.

The present invention also includes a method of using a trocar system **20** having the steps of detaching a cannula end housing **60** from a proximal end portion of a cannula body and removing tissue or other specimen as

understood by those skilled in the art from the cannula body **31**. The method can also include the end housing **60** having at least one valve **62, 66** positioned therein. The cannula end housing **60** and the cannula body **31** each have a substantially annular shape, and the cannula body **31** has a medial portion **33** having a first diameter and a proximal portion **34** connected to the medial portion **33** and having a second diameter. The second diameter is preferably larger or greater than the first diameter. The method can further include the detaching step including rotating the cannula end housing **60** a preselected rotational direction, e.g., counter-clockwise, and the at least one valve **62, 66** including a first and a second valve **62, 66** each connected to the cannula end housing **60** (see FIGS. 3-5 and 9-13).

Additionally, the present invention can include a method of using a trocar **40**. The method preferably has the steps of inserting a trocar **40** through the body **31** of a cannula **30**, retracting a shield **45** of the trocar **40** from a distal end portion **42** of the trocar **40** toward a proximal end portion **44** of the trocar **40** responsive to pressure on a distal end portion **46** of the shield **45**, and stopping the retracting of the shield **45** by the use of a transition region between a medial portion of the trocar and a proximal portion of the trocar or by the use of another stop member. The method can also include the trocar **40** having a handle **50** connected to a proximal portion **44** thereof, the handle **50** has a thumb rest **53** positioned on an outer surface thereof, and the step of inserting preferably includes pressing the thumb of a

user on the thumb rest **53** of the handle **50** when passing through the cannula body **31**.

In the drawings and specification, there have been disclosed a typical preferred embodiment of the invention, and although specific terms are employed, the terms are used in a descriptive sense only and not for purposes of limitation. The invention has been described in considerable detail with specific reference to these illustrated embodiments. It will be apparent, however, that various modifications and changes can be made within the spirit and scope of the invention as described in the foregoing specification and as defined in the appended claims.